Site Water Balance (SWB) Project Planning

Data Quality Objectives

Overview

Closure activities and final end-state have the potential to significantly alter groundwater and surface water flow at the Rocky Flats Environmental Technology Site (Site). Further, many Site closure decisions cannot be made without first considering quantified predictions of effects on groundwater and surface water flow. Therefore, a Site water balance must be prepared to assess current conditions as well as various closure scenarios to facilitate Site Closure decision-making. This document presents the data quality objectives used for planning and scoping the SWB. Details concerning data quality objectives (DQOs) for the model calibration and uncertainty analysis are provided under separate cover. DQOs for the SWB applications will be discussed as part of the application scoping.

Problem Statement

This project addresses the problem of determining to what degree Site closure will affect surface water and groundwater flow in the Woman and Walnut Creek drainages. This information will be applied to subsequent assessment of a number of Site closure issues including compliance with surface water action levels, impacts to biological resources, and end-state land configuration design.

The extent to which water balance modeling will facilitate individual Site closure decisions will depend on a number of factors, many of which cannot currently be assessed. These factors include:

- decision complexity;
- type, amount, and quality of existing hydrologic data;
- feasibility of collecting additional data; and
- capabilities and resolution characteristics of selected models.

Boundaries

The section contains a description of spatial and temporal boundaries for the water balance project. These general boundaries are the anticipated requirements for achieving the stated objectives and will be applied as such to the process of model selection. Following choice of the model(s), these boundaries may be further refined based on data availability and model analytical resolution, such that stated objectives are still adequately addressed.

Spatial: The Site water balance will serve to quantify surface water and tributary groundwater flow and interactions occurring within the Industrial Area, in the drainage pathways immediately downstream, and within the eastern Buffer Zone. More specifically, modeling will focus on the Woman and Walnut Creek drainages and associated upgradient groundwater source areas within the RFETS property boundary. This boundary is tentatively defined to the east by Indiana Street, to the west by the Laramie/Fox Hills Sandstone subcrop zone and west boundary, to the south by natural drainage divides and south boundary, and to

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the north by natural drainage divides. The Rock Creek drainage and the underlying deep regional aquifer systems are excluded from consideration because of their hydrological isolation from potential Industrial Area closure actions and effects.

Temporal: Field data collection and water balance model calibration will be conducted for a one year period (CY00) followed by an analysis of various closure scenarios assumed for final end-state conditions (post-closure CY07 and beyond).

Tentative Model Inputs

The following bulleted list is a presentation of the anticipated applicable data sets which are currently available or may need to be collected to complete the water balance. Modeling inputs will ultimately depend on model and scenario selections. Consequently, the following list is recognized as neither final nor all-inclusive.

Available Data

- 15-minute flow record from all Point of Evaluation and Compliance locations for several years
- 15-minute flow record from many other subdrainages across the Site
- WWTP effluent discharge data
- Surface water inflow data to Woman Creek
- Precipitation data
- Soil-type data
- Impervious surface area data (may need updating)
- Site-specific evaporation rates
- Daily to weekly pond transfer and pond level information
- Depth to bedrock
- Site geology
- Depth to groundwater
- Recharge as estimated by earlier models
- Hydraulic conductivity values
- Various Site GIS databases

Additional Data Model May Need

- Footing drain data
- Inflow data (Upper Church, McKay, DWB purchase)
- Treatment system outflow data
- Wetlands evaporation/ evapotranspiration rates
- Site-specific transpiration rates
- Seep flows
- Gain-loss studies
- Additional depth to groundwater data
- Additional hydraulic conductivity data
- Information such as upgradient mining plans, specific buffer zone and IA configuration closure options ...
- Compiled estimates of data error
- Additional IA precipitation data
- Updated impervious surface area coverage data for IA

Tentative Model Outputs

Table 1 presents a list of ideal and anticipated outputs for the water balance model. Related applications and decisions are presented in the adjacent columns. These tentative model outputs are the anticipated requirements for achieving the stated objectives and will be applied as such to the process of model selection. Following choice of the model(s), this list of outputs will be further refined based on model capabilities and analytical resolution, such that stated objectives are still adequately addressed.

Scenarios

The following list is a presentation of the anticipated scenarios to be modeled using the Site water balance model. These scenarios are broken down into current and post-closure scenarios. Post-closure scenarios are based on the best available current information, and are expected to evolve over the course of the project.

- **Current Conditions (CY00)**

  1. Subsurface Features

  - Active footing drains and utility corridors
  - Upgradient gravel mining/water management activities
  - Groundwater collection/treatment systems
    (Solar Ponds Plume, Mound Plume, East Trenches Plume ...)

  2. Above-Ground Features

  - Industrial Area land configuration
    (impervious surface areas, drainage pathways...)
  - Buffer Zone drainage pathway configuration
    (pond operation protocols, drainage configuration...)
  - Domestic-use WWTP effluent/Industrial Area discharges
    (DWB Raw Water Purchase, WWTP effluent discharge...)

- **Closure Conditions (Post-CY06)**

  1. Subsurface Variables

  - Removal of subsurface material and utilities
    (removal of foundations, footing drains, process lines, leakage...)
  - Upgradient gravel mining/water management activities
  - Groundwater collection/treatment systems
    (Solar Ponds Plume, Mound Plume, East Trenches Plume, future additional systems...)

  2. Above-Ground Variables

  - Industrial Area land configuration
    (removal of impervious surface area, design of environmental caps, design of runoff conveyances...)
  - Buffer Zone drainage pathway configuration
    (operation of ponds, removal of dams, construction of wetlands...)
  - Discontinuation of water importation/Industrial Area discharges

Table 1. Site Water Balance Model Outputs

Model Outputs	Applications*	Decisions
Spatial		
Surface water flow in major Site drainages at • Current Points of Evaluation and Compliance, • Outflow points for treatment cells, and • Other points to be determined pending input from Site Ecology and modeling consultant	All (see Applicability of Model Section)	For the applicable scenarios, what will be the surface water flow for an average water year for Walnut and Woman Creek at • Current Points of Evaluation and Compliance, • Outflow points for the treatment cells, and • Other points determined sensitive by Site ecology?
Storm runoff and recharge from IA	IA and BZ Configuration Design, Contaminant Transport Modeling, Risk Assessment	For the applicable scenarios, what will be the surface water runoff for an average water year to Walnut and Woman Creeks from the Site IA?
Evaporative depletions from ponds/wetlands	BZ Configuration, Ecological Impact Determinations	For the applicable scenarios, what will be the evaporative depletions for an average water year from ponds/ wetlands in Walnut and Woman Creeks?
Groundwater flux to Walnut and Woman Creeks (exact spatial distribution to be determined by model capabilities)	Contaminant Transport Modeling, Treatment System Management, Risk Assessment	For the applicable scenarios, what will be the groundwater flux for an average water year to Walnut and Woman Creeks?
Groundwater flux to IA	IA Configuration Design, Contaminant Transport Modeling	For the applicable scenarios, what will be the groundwater flux for an average water year to the IA?
Temporal		
Daily to monthly surface water flow	All	For the applicable scenarios, what will be the monthly/daily distribution of surface water flow (spatial distribution described above) given water years of low, average, and high annual precipitation?
Monthly to quarterly groundwater levels and fluxes	IA and BZ Configuration, Contaminant Transport Modeling, Treatment System Management, Risk Assessment	For the applicable scenarios, what will be the monthly/quarterly distribution of groundwater levels and fluxes for an average water year?
Design storms for surface water flow (1-, 2-, 5-, 10-, 25-, and 100-year events)	IA and BZ Configuration, Contaminant Transport Modeling, Ecological Impact Determinations, Negotiation of SW Standards, Risk Assessment	For the applicable scenarios, what will be the hydrograph of surface water flow (spatial distribution described above) for the following design storms: 1-, 2-, 5-, 10-, 25-, and 100-year events?

* See Applicability of Model Section for further discussion of applications.

3. Other Closure Conditions

- New/Innovative closure options/scenarios not currently considered above

Applicability of the Model

The results of the Site water balance study will be applied to help resolve a number of significant Site closure issues. These issues are presented below in no particular order of importance. The Site water balance is not intended to resolve these issues directly, but instead to provide a portion of the information required for their resolution. Additional applications for the model may be identified as the Site progresses toward closure; and consequently, the following is not presented as an all-inclusive list.

- Industrial Area (IA) Configuration at Closure

  The Site must determine how the IA will be configured at closure, considering proposed variables such as size and structure of environmental caps, runoff conveyance structures, re-grading, removal of foundations, footing drains, and other subsurface utilities, etc. The water balance is expected to provide predictions of groundwater and surface water flow regimes on the Site given these variables.

- Buffer Zone Configuration at Closure

  The Site must determine how the buffer zone will be configured at closure, considering proposed variables such as ponds configuration, number of ponds, pond operation protocols, manmade wetlands options, etc. The water balance is expected to provide predictions of groundwater and surface water flow regimes on the Site given these variables.

- Contaminant Transport to Surface Water

  The Site must determine whether contaminant transport modeling and particle tracking will be required for the Site to assure best management and compliance with surface water standards. The water balance is expected to provide predictions of groundwater and surface water flow regimes on the Site given the various closure scenarios to help resolve this issue. In that event that modeling is required, results of the Site water balance should prove valuable in this effort as well.

- Determination of the Ecological Impacts of Closure

  The Site must determine whether Site closure will adversely impact Site natural resources including wetland areas and other critical ecological areas, such as Preble's Meadow Jumping Mouse habitat. The water balance is expected to provide predictions of groundwater and surface water flow regimes on the Site given the various closure scenarios. This information should be valuable in the preparation of Biological Assessments and in the establishment of a baseline for natural resource damages.

- Management of In-Situ Treatment Systems

  The Site must determine whether the final Site configuration will adversely impact the ability of groundwater collection systems to capture groundwater flow and plume contamination compared to the pre-closure configuration. The water balance is expected to provide predictions of groundwater flow direction and flux given the various closure scenarios to help resolve this issue.

- Comprehensive Site Risk Assessment

  The Site must determine what will be the risk associated with the Site following closure. The water balance is expected to provide surface water and groundwater flow data for various closure scenarios to facilitate risk calculations.

- Negotiation of RFCA Surface Water Standards for Post-Closure Conditions

  The Site must work with regulators to determine what will be the appropriate standards and sample collection protocols for surface water at the Site following closure. The water balance is expected to provide predictions of surface water flow for various closure scenarios which should facilitate selection of appropriate standards and sampling protocols.